

The Wildest Urban River: Potomac River Gorge

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Biologists look for rare species in a pothole pool atop bluffs overlooking the Potomac River, on lower Bear Island. The scientists are, from left, Kate Kritcher, of the Maryland Department of Natural Resources; Stephanie Flack, Potomac Gorge project director for The Nature Conservancy; and Dianne Ingram, on the resource staff of the National Park Service. The pothole in the foreground supports several wetland plant species, including buttonbush (white flowers) and seedbox (yellow flowers). Photograph: R. Harrison Wiegand, Maryland Wildlife and Heritage Service.

Gary Fleming leads a small party across the tall bluffs, through the thick forest, and down the steep ravines that characterize the Virginia side of the Potomac River just north of Washington, DC. Fleming points to the stately beeches, plentiful tulip poplars, and majestic northern red and chestnut oaks that cover the hillsides, as well as to the understory of mountain laurel, sugar maples, and bladdernut. He revels in describing the Virginia bluebells, Dutchman's breeches, wild blue phlox, sessile trillium, and other wildflowers that carpet the forest floor here every spring in various shades of yellow, red, and blue.

"This is the finest forest I've seen in the Virginia Piedmont," says Fleming, a vegetation ecologist with the state's Department of Conservation and Recreation in Richmond. Fleming studies the plant communities that grow on the Virginia side of the Potomac as it passes through a 15-mile-long gorge from Great Falls to Georgetown in the District of Columbia. "I haven't seen anything like it in my 25 years of fieldwork."

Meanwhile, just across the Potomac in Maryland, Richard Wiegand traverses a shallow ravine between the historic Chesapeake and Ohio (C&O) Canal and the river. Occasionally, when a large flood roars down the Potomac, water fills the ravine. It has been more than 30 years since the last major flood came through the ravine, so the once-dominant prairie habitat is being replaced by a woodland of eastern red cedar, post oak, and Virginia pine. Losing out, at least for now, are such locally rare plants as wild false indigo, McDowell's sunflower, hairy wild petunia, and Canada milk vetch, a member of the bean family.



Clockwise, from the upper left, are hairy wild petunia, McDowell's sunflowers, jewelweed, and wild false indigo. Hairy wild petunia, an endangered species in Maryland, is reported only from a few sites in the Potomac Gorge. The late-flowering McDowell's sunflower, scattered in rocky habitat throughout the gorge, is listed as threatened in Maryland and reported only from Potomac Gorge. Jewelweed, common throughout Maryland and the mid-Atlantic region, is often covered with dew on early summer mornings, hence its name. Wild false indigo, listed as threatened in Maryland, is a prairie species uncommon in the mid-Atlantic region; in Maryland, it is reported only along the main stem of the Potomac. Photographs: R. Harrison Wiegand, Maryland Wildlife and Heritage Service.

"Hurricane Agnes washed away all the woody shrubs and trees in 1972," says Wiegand, a regional ecologist for the Wildlife and Heritage Service of the Maryland Department of Natural Resources. "The next big flood will wash them away again. The floods constantly change things. You may see a rare species in one area, then the floods will come through and wash it out. Some other plants will grow there instead. This is

one of the most biologically diverse habitats within the whole national park system."

A surprising diversity of plants

The Potomac River Gorge, as Fleming and Wiegand state, supports a surprising number of individual plant species and communities only a dozen miles from the nation's capital. Some are more usually found in the Blue Ridge and Ap-

alachian Mountains to the west. The gorge's different habitats—upland forests, dry bedrock terraces, floodplain woodlands and prairies, and ponds and marshes—create opportunities for what is perhaps the most diverse flora located within an urban area on the entire East Coast.

In all, more than 1400 different plants grow within the Potomac Gorge, including nearly 300 tracked as state species of

concern by Maryland, Virginia, or the District of Columbia. Some are rare species found in Maryland and Virginia only in the gorge. Others are common elsewhere but rare here. Scientists have identified about three dozen plant communities within the gorge, says Christopher Lea, a National Park Service botanist in Denver, Colorado, who has classified the Potomac's vegetation. At least three are not found anywhere else in the world.

The Potomac Gorge's biodiversity was recognized more than a century ago by scientists. "It would prolong this sketch unduly to enumerate all the rare and interesting plants" along the river, noted Lester F. Ward in 1881. "The flora along

the [C&O] canal is of special interest," added Alfred S. Hitchcock and Paul C. Standley in 1919. "The entire territory has proved of exceptional interest," wrote William R. Maxon in 1935. For decades, though, the gorge was largely forgotten until it was rediscovered by botanists with the Maryland and Virginia natural heritage programs in the 1980s and, more recently, by The Nature Conservancy. "They forced us to take stock of the Potomac," Lea says.

The Potomac River flows for 383 miles from Fairfax Stone in West Virginia to the Chesapeake Bay at Point Lookout, Maryland. The river's nearly 15,000-square-mile watershed covers portions of four

states—Maryland, Virginia, West Virginia, and Pennsylvania—plus the District of Columbia. It is the fourth largest watershed on the East Coast and the second largest (after the Susquehanna) emptying into the Chesapeake. Only a few, mostly small dams interrupt the river. "This is probably the wildest urban river anywhere in the world," states Matthew Logan, president of the Potomac Conservancy, a local environmental group.

Fortunately, more than half of the narrow stretch of land that constitutes the Potomac Gorge, along with much of the land along the full river, is protected. That includes parts of the 184.5-mile-long, 19,682-acre Chesapeake and Ohio (C&O) Canal National Historical Park on the Maryland side. The canal was built in the 19th century to connect the new nation's capital with the Ohio River to the west. Protected lands also include parts of the 25-mile-long, 7,300-acre George Washington Memorial Parkway in Virginia. The parkway administers two smaller preserves within the gorge—the 800-acre Great Falls Park and the 235-acre Turkey Run Park. Another 300 acres of the parkway lie on the Maryland side of the river.

All are units of the National Park Service (NPS). Together, they preserve "corridors of biodiversity," says Daniel Sealy, deputy director of NPS's Center for Urban Ecology in Washington. Additionally, two county parks in Virginia—Riverbend and Scott's Run—preserve about 750 acres near Great Falls. Further, The Nature Conservancy and the Potomac Conservancy own all or parts of Conn, Bear, and Minnie's Islands within the gorge.

Still, threats to the biodiversity of the Potomac Gorge exist. Exotic species not native to North America have been invading the area, some for decades. The exotics crowd out native species, including rare or unusual ones. An overabundance of deer similarly threatens rare plants. The deer alter the composition of plant communities by what they eat. Also, the growing numbers of visitors to the national and local parks stress the natural resources and the park staffs' ability to manage them. And the growth of the

region's population means that more land surrounding the Potomac River and its gorge is being developed, with a resultant increase in demand for water from the river and its tributaries.

Why the gorge is unique

What makes the Potomac Gorge so diverse biologically is its unusual geology, geography, and hydrology. The gorge traverses the fall zone between the harder, more erosion-resistant rocks of the inland Piedmont Plateau and the softer ones of the Atlantic coastal plains. As a result, in only two-thirds of a mile, the river falls 76 feet in a series of fast-flowing and dangerous rapids at Great Falls. Since the gorge spans two ecoregions, the area features plants characteristic of both. And, because of its Appalachian origins, the Potomac often carries seeds from plants usually found in the mountains and other nearby ecoregions and deposits them in the gorge.

The Potomac's bedrock terraces are an unusual geological feature found in few other rivers. Of nearby rivers, only the Susquehanna also has extensive bedrock terraces, and most of those are under water behind dams. The Potomac's terraces consist of sedimentary and metamorphic rocks. The rocks line the river bottom, jut from the numerous islands, and form tall bluffs overlooking the river. The half-mile-wide terraces are more extensive in Maryland. They provide a variety of habitats ranging from barren rock outcrops to temporary pools in small potholes and crevices to larger ponds in depressions and beyond to prairies and shrub- and tree-covered woodlands.

The Potomac's propensity to flood often also contributes to the area's striking geologic features. While the average annual flow is 12,327 cubic feet per second, the river can reach 1.4 million cubic feet during heavy flooding. That is more than enough to send water over the 50- to 60-foot-high cliffs on either side of the gorge. Even lesser floods scour many of the bedrock terraces and fill side channels, old oxbows, and inland ravines. They wash away years or decades of growth, rearrange the soils and plants, and deposit new sediments and seeds in



This pond maintains its water level during wet years but dries up during drought. Many wetland plants find habitat to support their growth, even if it is on rocky bluffs well above mean river level. Several rare plant species occur here. Photograph: R. Harrison Wiegand, Maryland Wildlife and Heritage Service.



Some species succeed at growing in rock clefts, such as the stiff aster (lavender flowers), which flowers in late summer and fall. Photograph: R. Harrison Wiegand, Maryland Wildlife and Heritage Service.

their place. Raging waters have created extensive floodplains on the Maryland side and eroded Virginia's steep cliffs. In 1996, two separate floods caused \$65 million in damages to the canal and park.

Beyond the Potomac's unusual geology and hydrology, researchers focus on the gorge's floral diversity. Botanist Lea has identified a dozen plant communities on Bear Island alone, an area once separated from the mainland by a side channel of the river but now easily accessed by foot from the C&O Canal. One Bear Island plant community is found in

forested areas between the canal and the rocks overlooking the river. It sports hickory, oak, and hop hornbeam trees and herbaceous plants such as Pennsylvania sedge.

Another plant community within the gorge consists of riverside prairies with only a few small trees and shrubs. Often covering just a few acres, these prairies feature the same Indiangrass, little bluestem, purple threeawn, and other grasses usually found in the Midwest. Lea once found 150 plant species in one 400-square-meter test plot, an unusually high

figure. Grasses and other prairie species can gain a foothold in the gorge, where floods wash out trees and shrubs every five years or so.

A more unusual grouping can be found on the bare bedrock terraces atop the tall cliffs of Bear Island. Here, the heavy rains of 2003, which nearly doubled the usual rainfall levels through the summer, created opportunities for plants that are not usually neighbors to grow next to each other. Wiegand points to the but-tonbush and seedbox flourishing in the thin soils filling a crevice between rocks. Alongside them grows orangegrass, a

small plant with tiny yellow flowers. Buttonbush and seedbox are marsh-loving plants usually found in wetlands, whereas orangegrass is a dry land species.

An even stranger sight lies just beyond the rocks in a woodland area where Wiegand finds a large patch of eastern prickly pear cacti. Unlike the bushlike prickly pears found throughout most of the Sonoran Desert of Arizona, California, and Mexico, eastern prickly pears are quite small and low to the ground. Despite their size, they bear the yellow flowers and purplish fruit characteristic of the genus. Prickly pears are found

scattered here and there in Maryland on dry, rocky areas, while in Virginia they are found only on sand dunes and rocky outcrops.

Over on the Virginia side of the river, Fleming hikes a trail surrounded by beech, hemlock, oak, and other trees, some topping 100 feet in height. The Maryland slopes and upland terraces have fewer trees that tall, he says. More interesting is the combination of northern red and chestnut oaks that form the forest canopy, with shorter sugar maples in the understory. Sugar maples, in particular, are common in the Appalachian Mountains but unusual on the Piedmont plateau and coastal plains, except in the Potomac Gorge, Fleming explains.

The Virginia side of the Potomac near Turkey Run has a much thicker hardwood forest because it faces north, Fleming says. The north-facing slopes feature richer soils and hold more water than the drier, south- and west-facing slopes and open terraces on the Maryland side. The steep hillsides and deep ravines on the Virginia side also discouraged settlers from clearing the land for farming. In some places, there has been no logging since the Civil War. And setting aside a narrow strip of land as a parkway in the 1950s and 1960s limited development on the bluffs overlooking the river.

Virginia's hillsides and ravines feature what Fleming calls "boulder fields," a geomorphic formation and plant community less common on the Maryland side. Boulder fields are large swaths of slopes covered with huge boulders and scads of variously sized smaller rocks. The boulders and rocks, thick in places, have broken off from outcroppings of the underlying bedrock on the hillsides as the river erodes the gorge westward faster than it does to the east. Between the rocks grow shrubs such as bladdernut and wildflowers like jewelweed.

Conservation challenges

Where the trail passes under the George Washington Memorial Parkway, Fleming points to microstegium, a common plant of the Potomac Gorge. An Asiatic grass, microstegium has invaded the gorge and other disturbed areas. Perhaps more than other nonnative plants, it



The Potomac River snakes between rock formations on Olmstead Island. This early morning view is from the popular footbridge that leads out to the viewing platform for Great Falls. Photograph: R. Harrison Wiegand, Maryland Wildlife and Heritage Service.

symbolizes the threat to the Potomac's rare and unusual species. Microstegium "may look beautiful and natural to some people, but it is an insidious weed, the way it grows thicker every year," Fleming says. "Invasives are the single largest challenge [to preserving the gorge's biodiversity] after development," adds Matt Berres of the Potomac Conservancy.

In all, 273 nonnative species have invaded the Potomac Gorge. Beyond microstegium, they include English ivy, Japanese honeysuckle, garlic mustard, and ailanthus (also called "tree-of-heaven"). Some are carried into the gorge from nearby suburban lawns and gardens by birds and the countless creeks and small streams. Many are washed away in floods, but others have gained a foothold and gradually expanded their range. The problem is greatest, Lea says, along low-lying plains near the river, which are more subject to flooding and disturbance than the more stable upland forests.

The Potomac Conservancy is actively removing Japanese honeysuckle and

other nonnative plants from Minnie's Island and elsewhere within the Chesapeake and Ohio Canal National Historical Park. Volunteers and staffers spend weekends ripping out the invasive vines, roots and all, sometimes applying chemical sprays to prevent their return. The National Park Service organizes similar programs for the canal and the George Washington Memorial Parkway. "It's a challenge," says Rod Sauter, the C&O Canal's supervisory interpretive ranger.

A similar challenge lies in the sheer number of deer residing in the Potomac Gorge's parks. Biologists estimate that the C&O Canal in Maryland averages 85 deer per square mile, while the George Washington Memorial Parkway in Virginia has 78, says Scott Bates, an NPS wildlife biologist. More than 40—and in some places more than 20—deer per square mile is usually considered too many, Bates adds.

Deer numbers for the C&O Canal and the parkway prior to 2000 are unknown, Bates says. Despite the current over-

abundance, the park service has no immediate plans to allow hunting within the national parks. That is not the case elsewhere in the gorge. At Riverbend Park in Virginia, park staff have been conducting deer hunts since 1998. In 2003 alone, 75 animals were killed. Riverbend still has "a ton of deer," says Martin Smith, the park's manager, but controlled hunts reduced its herd to more manageable levels.

A man-made problem concerns biologists at an area known as Chain Bridge Flats in Washington near Little Falls. Here, the US Army Corps of Engineers built a ditch in the 1920s to carry water to the nearby Dalecarlia Reservoir. Later, the ditch was altered to take overflow water from Dalecarlia back to the Potomac. A berm made from rocks removed during the ditch's construction and dumped on the downstream side prevents any but the largest floods from sweeping across the low-lying flats, while the ditch itself shunts floodwaters back to the river. As a result, nonnative species are replacing native ones, and drought-



Flowering prickly pear cactus grows in rocky pine-oak woodland on bluffs above the Potomac River. Photograph: R. Harrison Wiegand, Maryland Wildlife and Heritage Service.



Spring wildflowers, wild blue phlox and golden ragwort, bloom on a rich terrace near the Cropley area. Photograph: R. Harrison Wiegand, Maryland Wildlife and Heritage Service.

resistant sycamore and maple trees have formed a floodplain forest where more open woodland or prairie should be. The Nature Conservancy is hoping to convince the Corps of Engineers to fill the ditch and remove the berm, thus allowing the natural hydrology and vegetation of Chain Bridge Flats to reassert itself.

Yet another concern is the increasing demand for water from the Potomac. Some 5.2 million people live within the Potomac's watershed—4.6 million of them in Washington, DC, and its suburbs—up 13 percent since 1990. The river supplies Washington and its suburbs with 360 million gallons of water a day. As the human population around the nation's capital continues to grow, the gorge's natural diversity may decline for lack of sufficient water to sustain it, especially during droughts or other periods of low flow.

Beginning in the 1950s, the Corps of Engineers built a series of reservoirs along the Potomac to hold and treat water taken from the river to meet municipal needs in Washington and its suburbs. Until then, the river's water flow had never dipped below 450 cubic feet per second (cfs). In 2002, during the most recent drought, it dropped to 260 cfs, says Brian Richter, director of The Nature Conservancy's freshwater initiative. "We are stressing many species of plants," Richter adds. "None have gone extinct yet, but we are likely to see some population changes."

Park officials also face budget shortfalls that reduce their ability to monitor resources, maintain facilities, and hire staff. The C&O Canal, for example, has the same \$7.6 million budget for 2003 that it had the previous year. The result is a maintenance backlog totaling \$140 million and unfilled staff positions. For its

part, Riverbend (and other Fairfax County parks) in Virginia recently suffered a \$233,000 budget cut. Riverbend had to cut staff, halt most maintenance, and reduce hours, Smith says.

Add to that the sheer number of visitors who walk, hike, jog, bicycle, kayak, canoe, fish, or otherwise use the canal and river. The National Park Service estimates that nearly 3.5 million people visit the C&O Canal each year, with 1 million to 1.5 million visitors in the gorge itself. "The park is at risk of being loved to death," says Stephanie Flack, The Nature Conservancy's Potomac Gorge project director. "Many people are not aware of the damage they can do by simply walking off the trails. We hope to reach the public and educate them."

To that end, The Nature Conservancy, working with scientists and park managers, biologists, and rangers on both sides of the Potomac, has developed a conservation plan that represents the first comprehensive effort to identify conservation targets, monitor resources, and preserve the gorge's biodiversity, Flack says. The plan calls for the National Park Service and conservation groups, among others, to jointly map where invasive plant species are found, train and use volunteers to control them, set up fences to keep deer out of sensitive areas, and educate nearby landowners about maintaining their lawns and gardens to minimize the spread of exotic species into the parks.

The Potomac Gorge is "a unique and sensitive place that we all use," Flack says. "It has exceptional natural and cultural resources." In fact, the area's natural biodiversity "ranks within the top five national parks in the country," adds NPS's Lea. "Not all the diversity is in the western parks. We often overlook [the gorge's parks] because they are so close to the national capital. That makes them some of the most challenging parks to manage."

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